A METHOD TO DEVELOP AN 'INDICATOR VALUE' SYSTEM FOR SPIDERS USING CANONICAL CORRESPONDENCE ANALYSIS (CCA)

RALPH PLATEN

Platen, R. 1993 11 11: A method to develop an 'indicator value' system for spiders using Canonical Correspondence Analysis (CCA). *Memoirs of the Queensland Museum* 33(2): 621-627. Brisbane. ISSN 0079-8835.

Multivariate Canonical Correspondence Analysis (CCA) is used to derive 'indicator values' for spiders, similar to those used for plants. The data set consists of activity abundance values of spiders, sampled by pitfall trapping in various habitat types (mires, woods, dry grassland) in the Berlin area. Light exposure, soil moisture and temperature were also measured at the sites. Species scores are plotted as a function of environmental factors within an ordination diagram. The method used to determine the indicator value from this ordination diagram is presented. The system of indicator values is regarded as a suitable method to evaluate sites and areas easily. Advantages and limitations are discussed.
Mit Hilfe der multivariaten statistischen Methode Kanonische Korrespondenz Analyse (CCA) werden Zeigerwerte für Webspinnen, ähnlich denen für Pflanzen ermittelt. Die Entwicklung dieses Zeigerwertsystems und dessen Anwendung wird im Prinzip beschrieben. Der verwendete Datensatz besteht aus Aktivitätsabundanzwerten von Spinnen, die mit Bodenfallen in unterschiedlichen Biotoptypen (Mooren, Wäldern und Trockenrasen) im Gebiet von Berlin gefangen wurden. Die an den Standorten gemessenen abiotischen Faktoren Licht, Temperatur und Bodenfeuchte werden mit in die CCA einbezogen. An Hand von Beispielen wird der Weg erläutert, Zeigerwerte aus Ordinationsdiagrammen zu ermitteln. Mit Hilfe einiger Arten werden Anwendungsbereich und Beschränkungen des Zeigerwertsystems aufgezeigt und diskutiert. Das Zeigerwertsystem wird als eine brauchbare Methode betrachtet, um Standorte und Untersuchungsgebiete relativ leicht mit Hilfe der Spinnen zu bewerten. □ *Araneae, indicator value, multivariate analysis.*

Ralph Platen, Institut für Bodenzoologie und Ökologie, Freie Universität Berlin, Tietzenweg 85-87, W-1000 Berlin-45, Germany; 12 January, 1993

Ecosystems change under anthropogenic influences faster than their structures and functions can be analysed. It is therefore difficult to make well-founded comments about their ability to withstand external pressure, or about possibilities for their protection or renaturalisation. The complex ecological questions this deficit poses will require field work involving as many environmental factors and groups of organisms as possible.

GOALS

A first step is the description of the ecological behaviour of species in the field. A further step is to derive evaluations for the sites, biotopes or areas of study from the ecological behaviour of the species. For example when establishing whether an area should be protected, for purposes of planning and biotope-management as well as when studying the changes at the sites under anthropogenic influence, an efficient evaluation system which beyond that is easy to handle will be necessary.

A number of evaluation systems have recently been developed, e.g. for soil organisms by Wodarz *et al.* (1992), for epigaeic predatory arthropods (spiders and ground beetles) by Haenggi (1987) and Platen (1989, 1992), for spiders by Martin (1991) and for ground beetles by Mossakowski and Paje (1985). Some of these evaluation systems describe the ecological behaviour of the species in the field very precisely (Martin, 1991), or allow a differentiated evaluation of sitse or areas of study (Mossakowski and Paje, 1985; Haenggi, 1987; Platen, 1989). Some evaluation systems, however, have the disadvantage that lengthy calculations are necessary for synoptic evaluation for different sites or areas (Wodarz *et al.*, 1992; Haenggi, 1987). In other cases parameters are used in the calculations which are not stable for time and/or locality, such as a low local abundance of a species, or the numbers of individuals of a species caught in a year (Mossakowski and Paje, 1985). The evaluation systems mentioned can also only be applied locally where, as a result of intensive field work, the ecological behaviour of species along abiotic gradients is known.

A much simpler method would be the application of an indicator value system similar to that for plants of Ellenberg *et al.* (1991). It would then no longer be necessary to redetermine and re-evaluate the ecological behaviour of a species for each local investigation, since this would already be contained in the key values. Nor would the evaluation involve complicated calculations.

My aim has been to develop just such an indicator value system for spiders.

MATERIAL AND METHODS

Data

The data consisted of the activity abundances of spider species. These were determined using ground traps in the Berlin area for open and wooded sites in moors, in various types of forest and for heathland and semi-dry and dry meadows. The investigation period was a full year in each case. Activity abundance is defined by Heydemann (1953) as the number of individuals, which has been trespassed a borderline (which is represented by the diameter of the pitfall trap) within a certain period of time. Parallel to the trap catches the following abiotic factors were also measured:

The soil water content (measured as the percentage by volume of water in the upper soil layer), the light exposure using the method described by Friend (1961), and the effective temperature after Pallmannn *et al.* (1940). The sites are described in detail in Platen (1989).

General

The activity abundance of the spider species and the measurements of the abiotic factors are analysed using Canonical Correspondence Analysis (CCA; Jongman *et al.*, 1987), using the program CANOCO Version 3.10 (Braak, 1988, 1991). The results of this analysis are displayed as ordination diagrams using CANODRAW (Smilauer, 1990).

Before running CCA the spider data had been masked according to dominance in a formal way: species which did not have an activity abundance of at least 1% at a site were removed from the data set. This meant that of the original 281 spider species only 111 remained for the further analysis.

Furthermore a transformation of the raw data was carried out. Instead of the abundance values their square roots were used.

RESULTS

Ordination Diagrams

The CCA results with abiotic factors light exposure and temperature, as well as soil water content, are shown graphically (Figs 1, 2). The horizontal axis corresponds to the first CCA axis and the vertical to the second CCA axis. The 111 species of spider are represented by an 'x', together with an abbreviation of the name as far as possible. Using CANOPLOT it was also possible to determine the coordinates and the name of a species which could not be presented unambiguously in the diagram.

Initially the axes of the site factors light exposure and soil water content are extended beyond the origin (Fig. 1). The factor along the 'environmental axes' increases in the direction of the arrow. The origin marks the mean value for the entire data set. Species whose position lies between the arrowhead of an environmental axis and the origin have a larger weighted mean. Where the origin is between the arrowhead and the position of the species, its weighted mean is smaller than the overall mean. For interpretation a perpendicular is projected for each species in turn onto the environmental axis according to their sequence (cf. Jongman *et al.*, 1987). *Xysticus ninnii* and *Thanatus arenarius* occupy the brightest sites, and *Pardosa agrestis* and *Baryphyma pratense* the warmest sites (Fig. 1). Species at extremes of the axes represent limits of the area for a two-factor system, and thus form the start and end points of the indicator value scale. The distance between these points is measured and divided into five equal parts. The species are then noted for each class with the appropriate indicator value.

The determination of indicator values for three factors requires at least two ordination diagrams. Initially an indicator value is assigned for all three individual factors, then for all combinations of two factors. The result always remained the same. For the representation of all three factors in an ordination diagram the class of a species can, however, change, in some cases considerably, since the relative spatial distances of the species in three-factor constellations cannot be represented in a two-dimensional coordinate system without distortion. For the determination of indicator values from the data of individual environmental variables the solution (Figs 1 , 2) is an optimum.

Moisture is strongly negative correlated with the 1st CCA-Axis (Inter-set correlation: -0.919)

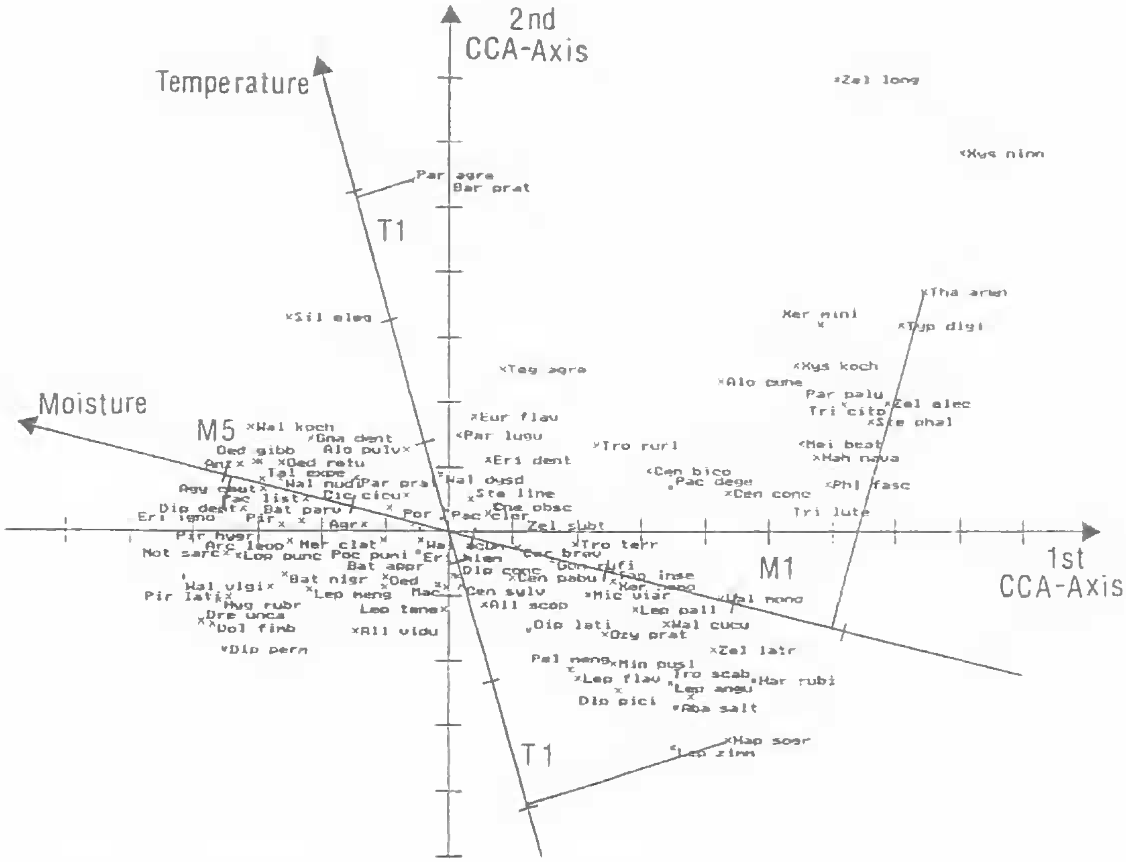

FIG. 1. CCA ordination diagram with 111 spider species represented by an 'x' and environmental variables moisture and temperature represented by arrows. The part of the arrows to derive indicator values are devided into five parts (M1-M5 and T1-T5 respectively). For further explanation see text.

(Fig. 1) which means that the horizontal species distribution is best explained by light and less by temperature (Inter-set correlation with 1st CCA-Axis: 0.26, with 2nd CCA-Axis: 0.538). Hence, the vertical species distribution is best explained along the 2nd CCA-Axis.

The Inter-set correlation between light and 1st CCA-Axis is 0.955 which means that the data set again is best explained by this abiotic factor. Temperature is strongly correlated with 2nd CCA-Axis (Inter-set correlation with 1st CCA-Axis: 0.0367, with 2nd CCA-Axis: 0.6177).

Indicator Values (Table 1)

The last two columns contain details of the ecological type and habitat type in which the species predominantly occurs in the Berlin area (after Platen *et al.*, 1991). The data are intended only to demonstrate the principle of this method. In view of the limited data set the indicator values cannot claim to be comprehensive or generally valid. Some examples will show the similarities and differences between the indicator values and other methods of determining ecological behaviour.

The distribution of *Xysticus ninnii* is centered exclusively on dry meadows. F1, L5, and T4 reflect this ecological behaviour well.

Diplocephalus permixtus: Occurring mostly in wet alder forest-habitats characterised by high soil water content, low light exposure and low temperatures. This is expressed with adequate precision by the indicator values F5, L1 and T2.

Diplocephalus picinus: F2, L1 and T1 characterise its habitat preferences, namely shadowy sites with low pH in dry mixed forests.

Pardosa agrestis: In this case the indicator value does not reflect the ecological behaviour, as a result of the inadequacy of the data set. The species occurs mostly on arable farmland and

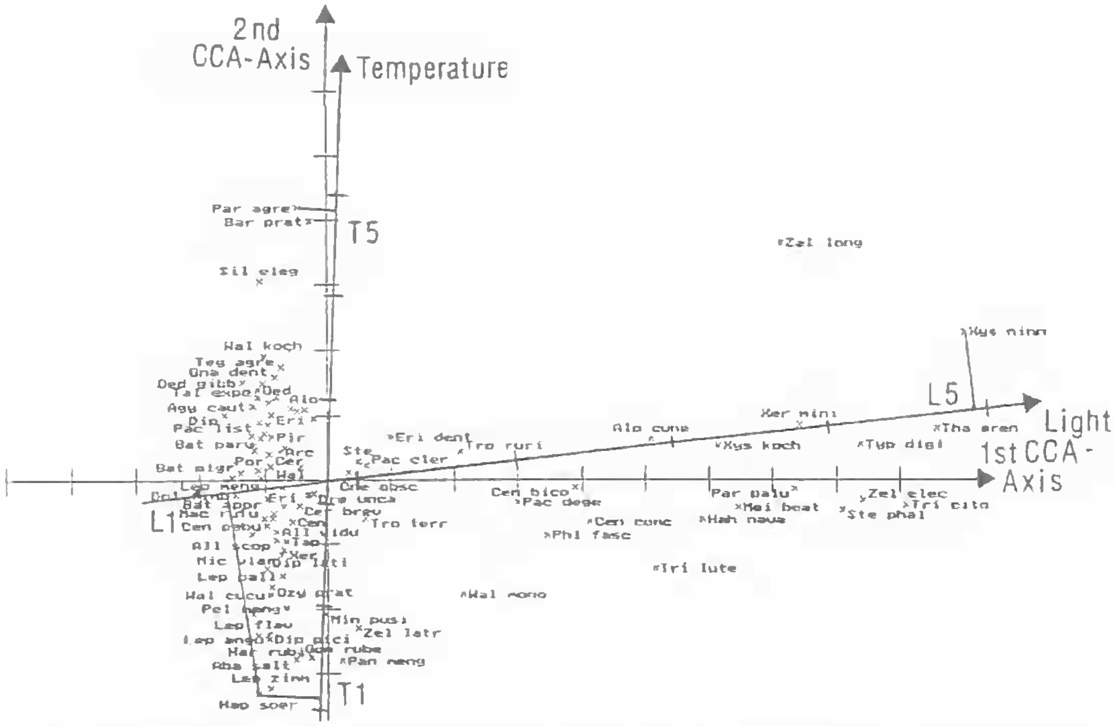

FIG. 2. CCA ordination diagram with 111 spider species represented by an 'x' and environmental variables light and temperature represented by arrows. The part of the arrows to derive indicator values are divided into five parts (L1-L5 and T1-T5 respectively). For further explanation see text.

other open, rather dry habitat types (Platen *et al.*, 1991). While T5 describes the behaviour in terms of temperature, the indicated soil water content (F5) is too high and the light exposure too low (L1). This is because in the data set it only occurred on one site (a former moor which was still wet in comparison to the sites on mineral soils), so that as an outsider it had an extreme position in the ordination diagram. The data set did not include arable farmland sites.

Comments

This method is a relatively easy one to determine indicator values for spiders and other soil arthropods (cf. Platen, 1992).

Indicator values have the advantage that with only a few values the ecological behaviour of a species can be characterised. Mean indicator values can be calculated, and in the absence of the measurements or vegetation surveys they allow a rough quantitative assessment of environmental variables for a investigation site, habitat type or an area of study. The use of indicator values obviates the need for complicated calculations for the evaluation of sites, as required by some evaluation systems (Mossakowski and Paje, 1985; Haenggi, 1987; Platen, 1989).

Some reservations concerning the applications of indicator values are necessary. As already emphasised by Ellenberg *et al.* (1991), indicator values describe the ecological behaviour of species in a multiple system of biotic and abiotic factors, from which those chosen in this paper are regarded as the key abiotic factors for the spiders. They do not, however, describe their physiological optima.

Indicator values for animals underlie more restrictions as those for plants because animals are mobile and often change their habitat for overwintering (Schaefer, 1976). Therefore in the strict sense they are valid only for Adults which does not change their habitat within their period of maturity. As juvenile animals were not included in the data set this holds true for this investigation.

Indicator values should never be used in the same way as measurements. They are ordinal, and are not suited for use in statistical (including multivariate) methods requiring higher scale data.

The indicator values determined above are always valid only for the data set used. Since they were limited to only a few types of biotope the results above can only be regarded as being a first approximation. The results of the analysis are greatly dependent on the type and number of habitats types and of the frequency with which various species occur there. The combination of a wet, light site (F5, L5) is not represented by an indicator value, although it is relevant for a number of species (*Drepanotylus uncatus*, *Antistea elegans*) (Table 1). However, since almost 2/3 of the 30 sites investigated were wet, and most species occurred with almost the same frequency in wet habitats, these species grouped close to the origin. Species which occur frequently, but only at one or two dry sites with very high light exposure are far from the origin, so that there is a higher differentiation of the axis over the bright range.

A generally valid indicator value system would need to analyse all known spider species of Germany or Central Europe for all existing types of biotope (abiotic factor combinations) in one data set, from which the indicator values could then be derived. The scale could then be expanded, or other environmental factors, such as the biotope structure, could be included. A problem would be the large number of measurements required.

A further problem is that the CCA only depicts species correctly in the ordination diagram if they have an unimodal response curve along a factor gradient (Jongman *et al.*, 1987). By plotting the frequencies of species at all habitat types sorted according to the levels of a factor, it is possible to determine bi-modal, multi-modal or continuous responses. The coordinates of all the habitats where the species occurs with high frequency can be entered in the ordination diagram, making it possible to recognise a corresponding range of occurrence on the environmental axis. For this species, as is the case with some plant species, an indifferent response to this factor for the species or to give a range of the indicator value (cf. Ellenberg *et al.*, 1991) may be possible.

ACKNOWLEDGEMENTS

For ideas, criticism and discussion I would like to thank Florian Bemmerlein-Lux, Nuremberg, Prof. Lasco Mucina, Vienna, and Prof. Gerd Weigmann, Berlin.

LITERATURE CITED

BRAAK, C.J.F. TER 1988. CANOCO - a FORTRAN program for canonical community ordination by [partial] [detrended] [canonical correspondence analysis, principal components analysis and redundancy analysis (Version 2.1)]. Technical report LWA 88-02, Groep Landbouwwiskunde, Wageningen.

1990. Update notes: CANOCO Version 3.10. Manuscript, Agricultural Mathematics Group, Wageningen.

ELLENBERG, H., WEBER, H.E., DÜLL, R., WIRTH, V., WERNER, W. & PAULISSEN, D. 1991. Zeigerwerte von Pflanzen in Mitteleuropa. Scripta Geobotanica XVIII: 1-248.

FRIEND, D.T.C. 1961. A simple method of measuring integrated light values in the field. Ecology 42: 577-580.

HÄNGGI, A. 1987. Die Spinnenfauna der Feuchtgebiete des Großen Mooses, Kt. Bern. 2. Die Beurteilung des Naturschutzwertes naturnaher Standorte anhand der Spinnenfauna. Mitteilungen der Naturforschenden Gesellschaft in Bern N.F. 44: 157-185.

HEYDEMANN, B. 1953. Agrarökologische Problematik, dargetan an Untersuchungen über die Tierwelt der Bodenoberfläche der Kulturfelder. (Thesis, Kiel). 433 pp.

JONGMAN, R.H.G., BRAAK, C.J.F. TER & TONGEREN, O.F.R. (eds.), 1987. 'Data analysis in community and landscape ecology.' (Pudoc Books: Wageningen).

MARTIN, D. 1991. Zur Autökologie der Spinnen (Arachnida: Araneae) I. Charakteristik der Habitatausstattung und Präferenzverhalten epigäischer Spinnenarten. Arachnologia Mitteilungen 1: 5-26.

MOSSAKOWSKI, D. & PAJE, F. 1985. Ein Bewertungsverfahren von Raumeinheiten an Hand der Carabidenbestände. Verhandlungen, Gesellschaft Ökologie in Bremen 1983 13: 747-750.

PALLMANN, H., EICHENBERGER, E. & HASELER, A. 1940. Eine Methode der Temperaturmessung bei ökologischen oder bodenkundlichen Untersuchungen. Berichte, Schweizerische Botanische Gesellschaft 50: 337-362.

PLATEN, R. 1989. Struktur der Spinnen- und Laufkäferfauna (Arach.: Araneida, Col.: Carabidae) anthropogen beeinflußter Moorstandorte in Berlin (West); taxonomische, räumliche und zeitliche Aspekte. (Thesis: Technische Universität Berlin) 470 pp.

PLATEN, R., MORITZ, M. & BROEN, B.v. 1991. Liste der Webspinnen- und Weberknechtarten (Arach.: Araneida, Opilionida) des Berliner Raumes und ihre Auswertung für Naturschutzzwecke (Rote Liste). Pp. 243-275. In A. Auhagen, R. Platen and H. Sukopp (eds). 'Rote Listen der gefährdeten Pflanzen und Tiere in Berlin'.(Landschaftsentw.: Umweltforsch, S6).

PLATEN, R. 1992. Die Entwicklung eines Zeigerwertsystems für Laufkäfer (Col.: Carabidae) mit Hilfe einer "Canonical Correspondence Analysis"

(CCA). Verhandlungen der Gesellschaft für Ökologie 21: 321-326.

SCHAEFER, M. 1976. Experimentelle Untersuchungen zum Jahreszyklus und zur Überwinterung von Spinnen (Araneida). Zoologische Jahrbücher, Systematik (Ökologie), Geographie und Biologie 103: 127-289.

SMILAUER, P. 1990. CANODRAW. A companion program to CANOCO for publication-quality graphical output. (Ithaca).

WODARZ, E., AESCHT, E. & FOISSNER, W. 1992. Der Bodenbiologische Index (BI) - ein quantitatives Maß für die Bodenqualität. Verhandlungen der Gesellschaft für Ökologie 21: (in press).

TABLE 1. Indicator values for soil water content (F), light (L), temperature (T) of 111 common spider species of varying types of habitat. ET=Ecological type: h = hygrophilic, (h) = weakly hygrophilic, x=xerophilic, (x)=weakly xerophilic, eu= euryoccious open-space dwellers, w=forest type, (w) = also in open spaces, hw=sparse forest species, (h)w=inhabits mesophilic deciduous forests, (x)w=inhabits forest on acid soil, h(w)=depending on type of preferred habitat: inhabits unwooded wet habitats or sparse forest. - = no preferred habitats. Family (C): Ag, Agelenidae; Dy, Dysderidae; Gn, Gnaphosidae: Ha, Hahniidae; Li, Linyphiidae; Lc, Liocranidae; Ly, Lycosidae; Ph, Philodromidae; Pi, Pisauridae; Sa, Salticidae; Te, Tetragnathidae; Tr, Theridiidae; Tm, Thomisidae; Zo, Zoridae.

SPECIES	F	L	T	ET	C
Wet Forests					
Pachygnatha listeri Sundevall	5	1	3	hw	Te
Bathyphantes approximatus (O.P.C.)	4	1	3	h(w)	Li
B. nigrinus (Westring)	5	1	3	hw	Li
Diplacephalus permixtus (O.P.C.)	5	1	2	h(w)	Li
Diplastyla cancalar (Wider)	4	1	2	(h)(w)	Li
Ganatium rubellum (Blackwall)	3	1	2	hw	Li
Porrhamma pygmaeum (Blackwall)	4	1	3	h(w)	Li
Walckenoeria atrotibialis (O.P.C.)	4	1	2	(w)	Li
Pirata hygrophilus (Thorell)	5	1	3	h(w)	Ly
Deciduous forests					
Centromerus sylvaticus (Blackwall)	4	1	2	(h)w	Li
Ceratinella brevis (Wider)	3	1	2	(h) w	Li
Diplocephalus latifrons (O.P.C.)	3	1	2	(h)w	Li
Gongylidium rufipes (Sundevall)	3	1	2	(h)(w)	Li
Lepthyphantes pallidus (O.P.C.)	2	1	2	(h)(w)	Li
L. tenebricala (Wider)	4	1	2	(h)w	Li
L. zimmermanni Bertkau	2	1	1	(h)w	Li
Micraneta viaria (Blackwall)	3	1	2	(h) w	Li
Neriene clathrata (Sundevall)	4	1	3	(h) w	Li
Pardasa lugubris (Walckenaer)	4	1	3	(h) w	Ly
Dry mixed forests					
Harpactea rubicunda (C.L. Koch)	1	1	1	(x)w	Dy
Abacoproeces saltuum (L. Koch)	2	1	1	(x)w	Li
Centramerita concinna (Thorell)	2	3	2	(x)(w)	Li
Centromerus pabulator (O.P.C.)	3	1	2	(x)(w)	Li
Diplocephalus picinus (Blackwall)	2	1	1	(x)w	Li
Gonatium rubens (Blackwall)	2	1	1	(x)w	Li
Lepthyphantes angulipalpis (Westring)	2	1	1	(x)w	Li
Lepthyphantes flavipes (Blackwall)	2	1	1	(x)w	Li
Macrargus rufus (Wider)	4	1	2	(x)w	Li
Minyrialus pusillus (Wider)	2	1	1	(x)w	Li
Panamamops mengei Simon	1	1	1	(x)w	Li
Topinacyba insecta (L. Koch)	2	1	2	(x)w	Li
Walckenaeria acuminata Blackwall	4	1	3	(x)w	Li

SPECIES	F	L	T	ET	C
W. cucullata (C.L. Koch)	2	1	2	(x)w	Li
W. dysderoides (Wider)	4	1	3	(x)w	Li
W. monoceros (Wider)	2	2	2	(x)w	Li
Euryapis flavomaculata (C.L. Koch)	4	1	4	(x)(w)	Tr
Trochasa terricola Thorell	3	2	2	(x)(w)	Ly
Xeralycosa nemaralis (Westring)	2	1	2	(x)(w)	Ly
Cicurina cicur (Fabricius)	4	1	3	(x)(w)	Ag
Agraeca brunnea (Blackwall)	4	1	3	(w)	Lc
Haplodrassus soereuseni (Strand)	1	1	1	(x) w	Gn
Zelates subterraneus (C.L. Koch)	3	1	3	(x)(w)	Gn
Ozyptila praticola (C.L. Koch)	2	1	2	(x) w	Tm
Waterside sites					
Gnathanarium dentatum (Wider)	5	1	4	h	Li
Moors					
Agyneta cauta (O.P.C.)	5	1	3	h(w)	Li
Diplocephalus dentatus Tullgren	5	1	3	h(w)	Li
Drepanatylus uncatus (O.P.C.)	5	1	3	h	Li
Eriganella ignabilis (O.P.C.)	5	1	3	h	Li
Lepthyphantes mengei Kulczynski	5	1	3	h(w)	Li
Lophamma punctatum (Blackwall)	5	1	3	h	Li
Notioscopus sarcinatus (O.P.C.)	5	1	3	h	Li
Oedothorax gibbosus (Blackwall)	5	1	4	h	Li
Silametopus elegans (O.P.C.)	5	1	5	h	Li
Tallusia experta (O.P.C.)	5	1	4	(h)	Li
Walckenaeria alticeps Blackwall	5	1	4	h(w)	Li
W. kochi (O.P.C.)	5	1	4	h	Li
W. nudipalpis (Westring)	5	1	4	h	Li
W. vigilax (Blackwall)	5	1	3	h	Li
Arctosa leopardus (Sundevall)	5	1	3	h	Ly
Hygralycasa rubrofasciata (Ohlert)	5	1	3	h	Ly
Pardasa pullata (Clerck)	5	1	3	h	Ly
P. latitans (Blackwall)	5	1	3	h	Ly
P. piraticus (Clerck)	5	1	3	h	Ly
P. piscatorius (Clerck)	5	1	3	h	Ly
P. tenuitarsis Simon	5	1	4	h	Ly
Trachasa spinipalpis (F.O.P.C.)	5	1	3	h(w)	Ly

TABLE 1. *continued*

SPECIES	F	L	T	ET	C
Dolomedes fimbriatus (Clerck)	5	1	3	h	Pi
Antistea elegans (Blackwall)	5	1	4	h	Ha
Reeds					
Baryphyma pratense (Blackwall)	5	1	5	h	Li
Wet Meadows					
Allomengea scopigera (Grube)	3	1	2	h	Li
A. vidua (L. Koch)	4	1	2	h	Li
Ceratinella brevipes (Westring)	4	1	3	h	Li
Erigonella hiemalis (Blackwall)	4	1	3	(h)(w)	Li
Oedothorax fuscus (Blackwall)	4	1	2	eu	Li
O. retusus (Westring)	5	1	4	eu	Li
Pelecopsis mengei (Simon)	3	1	1	h	Li
Pardosa palustris (Linné)	1	4	3	eu	Ly
P. prativaga (L. Koch)	4	1	3	eu	Ly
Cough-grass sites					
Centromerita bicolor (Blackwall)	2	3	3	(x)(w)	Li
Ruderal sites					
Bathyphantes parvulus (Westring)	5	1	3	eu	Li
Pocadicnemis pumila (Blackwall)	4	1	3	eu	Li
Stemonyphantes lineatus (Linné)	4	2	3	(x)	Li
Trochosa ruricola (De Geer)	3	2	3	eu	Ly
Arable fields					
Bathyphantes gracilis (Blackwall)	4	1	3	eu	Li
Erigone atra (Blackwall)	3	2	3	eu	Li
E. dentipalpis (Wider)	4	2	3	eu	Li
Pardosa agrestis (Westring)	5	1	5	(x)	Ly
Tegenaria agrestis (Walckenaer)	4	1	4	(x)	Ag
Heathland					
Tricca lutetiana (Simon)	1	3	2	(x)	Ly
Zelotes latreillei (Simon)	2	1	1	(x)	Gn
Dry grassland					
Pachygnatha degeeri Sundevall	2	2	3	eu	Te
Meioneta beata (O.P.C.)	1	4	3	x	Li
Trichopterna cito (O.P.C.)	1	5	3	x	Li
Troxochrus scabriculus (Westring)	2	1	1	x	Li
Typhochrestus digitatus (O.P.C.)	1	5	3	x	Li
Steatoda phalerata (Panzer)	1	5	3	x	Tr
Alopecosa cuneata (Clerck)	2	3	3	x	Ly
A. pulverulenta (Clerck)	4	1	3	eu	Ly
Xerolycosa miniata (C.L. Koch)	1	4	4	x	Ly
Hahnia nava (Blackwall)	1	4	3	x	Ha
Agroeca proxima (O.P.C.)	4	1	3	(x)	Lc
Zelotes electus (C.L. Koch)	1	5	3	x	Gn
Z. longipes (L. Koch)	2	4	5	x	Gn
Thanatus arenarius L. Koch	1	5	4	x	Ph
Xysticus kochi Thorell	1	4	3	x	Tm
X. ninnii Thorell	1	5	4	x	Tm
Aelurillus v-insignitus (Clerck)	1	5	4	x	Sa
Phlegra fasciata (Hahn)	1	3	2	x	Sa
No obvious habitat preferences					
Cnephalocotes obscurus (Blackwall)	3	1	3	eu	Li
Zora spinimana (Sundevall)	4	1	3	eu	Zo